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(58) Field of Search

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(54) Abstract Title

Bushing with variable-diameter central passage forming bearing surface

(57) A sintered bronze bushing 10 with a cylindrical outer surface 12 and two axial end faces 14 has a central through passage 16 forming the bearing surface of the bushing. The internal diameter of the passage varies along the length of the passage, with sections of the passage having either a constant diameter 20 or a variable diameter 22,24. The through passage is joined to the end faces by chamfered sections 18. In a miniature motor the use of the bushing permits use of a rotor shaft which is slightly bent.

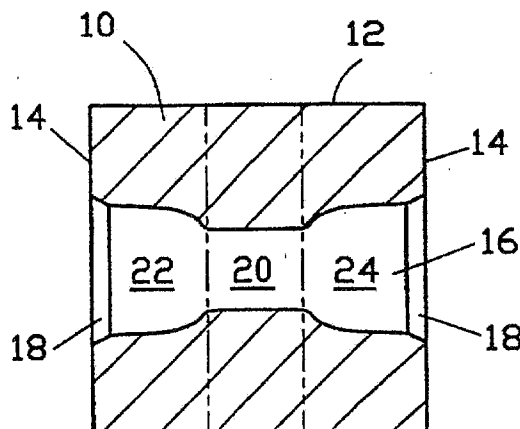


FIG. 1

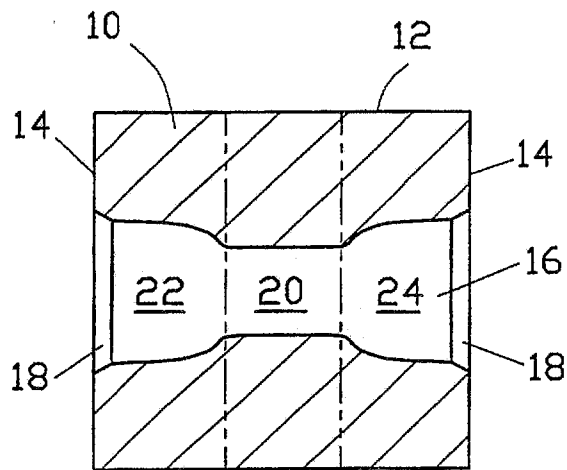


FIG. 1

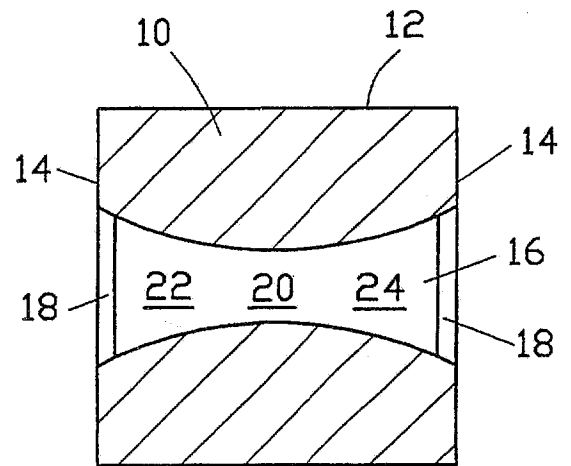


FIG. 2

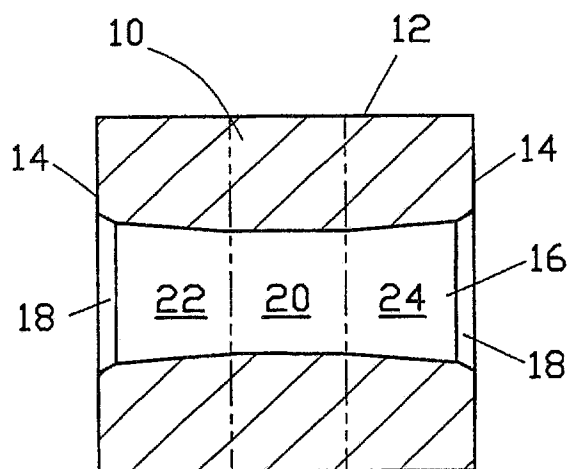


FIG. 3

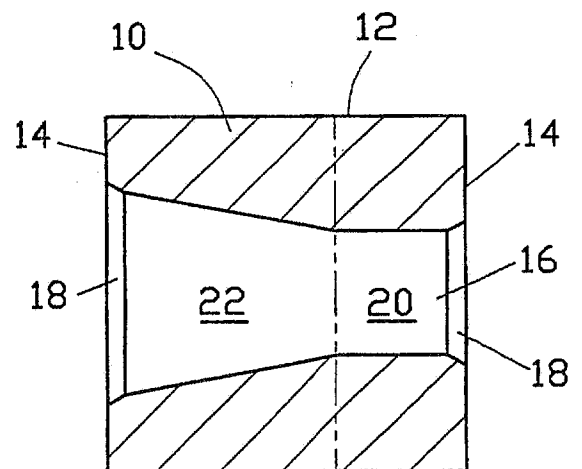


FIG. 4

Bearing

This invention relates to bearings and in particular, to a sleeve bearing or bushing for use with a miniature electric motor.

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Bushings are often used in mass produced miniature motors because of cost considerations while providing adequate performance and life. However, miniature electric motors are prone to bent shafts which while the appliance may be able to accept a limited degree of bentness, the bushings may be damaged by the bent shaft or
10 the added friction may cause the motor to malfunction. Self-aligning bushings are known and although their primary function is to correct misalignment between the bearings, they can accommodate shafts which are slightly bent. However, self-aligning bearings are more expensive.

15 Hence, there is a need for a sleeve bearing or bushing which can accept a shaft which is slightly bent.

The present invention provides such a bushing by providing a bushing with an inner surface which is not a true cylindrical surface.

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Accordingly, the present invention provides a sintered bushing for use with a miniature electric motor comprising a body having a generally cylindrical outer surface, two substantially flat end faces and a central axially extending and generally circular cross-section through passage forming the bearing surface, the through
25 passage being joined to the end faces by chamfered sections. The passage has an inner diameter which varies along the length of the passage.

Preferably, the inner diameter is larger adjacent the end faces than at the mid point between the end faces.

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Preferably, the through passage is tapered from one end face towards the other end face.

Preferably, the passage has a double taper from a region of minimum internal
35 diameter towards the end faces.

Preferably, the angle of the taper is in the range of 2° to 10°.

Preferably, the passage has a first region with a minimum internal diameter, a second region with a larger internal diameter adjacent a first one of the chamfered sections and a profile which smoothly connects the first region to the second region.

- 5 Preferably, the passage also has a third region with an internal diameter larger than the minimum internal diameter adjacent the second one of the chamfered sections and the profile of the through passage is smooth from the second region to the third region.
- 10 Preferably, the first section covers approximately one third of the length of the through passage.

Brief Description of the Drawings

- Preferred embodiments of the invention will now be described, by way of example
 15 only, with reference to the accompanying drawings in which:

Figure 1 is a cross sectional view of a bushing according to a first embodiment;

Figure 2 is a cross sectional view of a bushing according to a second embodiment;

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Figure 3 is a cross sectional view of a bushing according to a third embodiment; and

Figure 4 is a cross sectional view of a bushing according to fourth embodiment.

25 Detailed Description of Preferred Embodiments

- The first embodiment of the bushing is shown in Figure 1. The bushing comprises a sintered bronze body 10 having a generally cylindrical outer surface 12 and two axial end faces 14. Extending between the end faces 14 is a central through passage 16. Passage 16 is connected to the end faces by chamfered sections 18. Passage 16 forms
 30 the bearing surface of the bushing. Passage 16 has three sections, a first section 20, a second section 22 and a third section 24.

- Passage 16 has a generally circular cross section with an internal diameter which varies along its length. First section 20 has a constant diameter which is the smallest
 35 diameter of the passage. Second section 22 has a diameter which increases from the first section to the chamfered section 18 adjacent the end face 14. Third section 24 is symmetrical to the second section.

The second embodiment shown in Figure 2 is of similar construction to the first embodiment except that the width of the first section 20 is very narrow and the connection between the first section and the second and third sections (22, 24) is not distinct, creating an inner diameter which is substantially constantly changing along the length of the passage 16 creating a crown-like shape in the longitudinal profile of the passage.

The third embodiment, as shown in Figure 3, is of similar construction to the first embodiment except that the second and third sections (22, 24) are generally tapered although the edge between the second and third sections and the first section may be smoothed to remove any sharp corners or joins. The tapers are preferably in the range of 2° to 10° and ideally are about 5° . The first, second and third sections (20, 22, 24) may be of substantially equal length, i.e., each section being about one third of the length of the through passage 16.

The fourth embodiment as shown in Figure 4 is of similar construction to the third embodiment except that the third section has been omitted, i.e., the length of the third section is zero. Hence, passage 16 has only a first section of a constant diameter and a second section of tapering diameter, diverging from the first section to one of the chamfered sections. The other side of the first section connects directly to the other chamfered section. The length of the first section may be varied depending on the requirements of the application but preferably is still one third of the length of the through passage 16.

The chamfered sections 18 are provided to assist with fitting a shaft to the bearing and are a common feature of such bushings.

In use, the bushing of each embodiment provides a stable bearing surface which because of the diverging profile of the bearing surface, can accommodate shafts which are bent slightly more than could be previously accepted without unduly increasing the friction between the shaft and the bushing or damaging the bearing surface of the bushing.

Although several preferred embodiments have been described, it will be obvious to those skilled in the art that various modifications can be made to those embodiments described without departing from the spirit of the invention and it is intended to cover all such variations as fall within the scope of the invention as defined by the appended claims.

Claims

1. A bushing for use with a miniature electric motor comprising:
a body having a generally cylindrical outer surface;
5 two substantially flat end faces; and
a central axially extending generally circular cross sectional passage forming a bearing surface; the through passage being joined to the end faces by a chamfered sections characterised in that
the passage has an inner diameter which varies along the length of the passage.
10
2. A bushing according to claim 1 wherein the internal diameter is larger at the end faces than at the mid point between the end faces.
3. A bushing according to claim 1 or claim 2 wherein the through passage is
15 tapered from one end face towards the other end face.
4. A bushing according to claim 1 or claim 2 wherein the passage has a double taper from a region of minimum diameter towards the end faces.
- 20 5. A bushing according to claim 3 or claim 4 wherein the taper has an angle to the axis within the range of 2° to 10° .
6. A bushing according to any one of the preceding claims wherein the passage has a first region with a minimum internal diameter, a second region with a larger
25 internal diameter adjacent a first one of the chamfered sections and a profile which smoothly connects the first region to the second region.
7. A bushing according to claim 6 wherein the passage has a third section with an internal diameter larger than the minimum internal diameter located adjacent the
30 second one of the chamfered sections and the profile of the through passage is smooth from the first region to the third region.
8. A bushing according to claim 6 or claim 7 wherein the first section extends for approximately one third of the length of the passage.
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9. A bushing according to claim 7 wherein the first section, the second section and the third section each cover approximately one third of the length of the passage.

10. A bushing according to any one of the preceding claims wherein the body is of sintered bronze material.

11. A bushing for a miniature electric motor substantially as hereinbefore
5 described with reference to the accompanying drawings.



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Claims searched: 1 to 11

Examiner: T P Marlow
Date of search: 4 November 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F2A: (AD44)

Int Cl (Ed.6): F16C: 33/04, 33/06, 33/16, 33/20, 33/26 H02K: 7/08

Other: ONLINE: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2,207,961	DAIDO - see especially figures 5D and 5E	1,2
Y	GB 2,174,154	ITT - see figure 2	1 to 7,10
Y	GB 921,351	BRAUN - see whole document	1 to 7,10
Y	GB 548,744	LANDIS & GYR - see whole document	1 to 7,10
X	US 5,018,752	THOMAS - see figure 3	1
X	US 3,994,542	WOJDYLA - see especially figure 3	1 to 9

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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